IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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I am knowledgeable in the English language, and in the French language in which the below identified application was filed, and that I believe the annexed English translation of the certified copy of French Patent Application No. 0005346 filed on 25th April 2000 to be a true and complete translation of the above identified application as filed.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that wilful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such wilful false statements may jeopardise the validity of the application or any patent issued thereon.

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For the Director-General
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The Head of the Patents Section

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PATENT OF INVENTION
UTILITY CERTIFICATE
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REQUEST FOR GRANT 1/2

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SUBMISSION OF ITEMS DATE 25.04.00 PLACE 99 NATIONAL REGISTRATION NO. 0005346 ASSIGNED BY INPI DATE OF FILING ASSIGNED 25th APRIL 2000 BY INPI	Manufacture Française des Pneumatiques MICHELIN Michel BOLINCHES Service SGD/LG/PI-LAD 63040 CLERMONT-FERRAND CEDEX 09
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Patent application	☒
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or initial application for a utility certificate	No. Date
Conversion of a European patent application	☐
Initial patent application	No. Date

3. TITLE OF THE INVENTION (200 characters or spaces maximum)

Process for manufacturing a tyre safety support and support obtained by this process

4. DECLARATION OF PRIORITY OR REQUEST TO BENEFIT FROM THE DATE OF FILING OF A PRIOR FRENCH APPLICATION	Country or organisation Date No. Country or organisation Date No. Country or organisation Date No. ☐ **If there are other priorities, tick the box and use the "Continuation" form**
5. APPLICANT	☒ **If there are other applicants, tick the box and use the "Continuation" form**
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PATENT OF INVENTION
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6. AGENT		
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The inventors are the applicants		☐ Yes ☒ No **In this case, provide a separate designation of inventor(s)**
8. SEARCH REPORT		**Solely for a patent application (including divisional and conversion)**
	immediate	☒
	or deferred	☐
Payment of the fee in instalments		**Payment in three instalments, solely for individuals** ☐ Yes ☐ No
9. REDUCTION IN THE AMOUNT OF FEES		**Solely for individuals** ☐ Requested for the first time for this invention *(attach tax exemption certificate)* ☐ Requested prior to this filing *(attach copy of the decision of acceptance for this invention or indicate the reference number thereof):*
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10. SIGNATURE OF THE APPLICANT OR AGENT (Name and position of the signatory)	**STAMP OF THE PREFECTURE OR INPI**
For MFPM – Agent 422-5/S.020 (signature) Michel BOLINCHES	(signature) MARTIN

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PATENT OF INVENTION
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4. DECLARATION OF PRIORITY OR REQUEST TO BENEFIT FROM THE DATE OF FILING OF A PRIOR FRENCH APPLICATION		Country or organisation Date No. Country or organisation Date No. Country or organisation Date No.
5. APPLICANT		
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DOCUMENT COMPRISING MODIFICATIONS

PAGE(S) OF THE DESCRIPTION OR THE CLAIMS OR PAGES OF THE DRAWING			M.C. *	DATE OF CORRESPONDENCE	DATE STAMP OF THE CORRECTING OFFICIAL
Modified	Cancelled	Added			
14 to 17	18			20/7/2000	BC – 27th JULY 2000
		sh. 1		20/7/2000	BC – 27th JULY 2000

*Any amendment made to the draft of the original claims, unless ensuing from the provisions of Article R612-36 of the Code of Intellectual Property, is indicated by the note "M.C." (modified claims).

The present invention relates to a process for manufacturing a cross-linked, expanded elastomeric safety support of cellular structure having closed cells, said support being intended to be mounted on a wheel rim within a tyre, a cross-linkable, expandable blank intended to constitute said support in the cross-linked, expanded state, such a support and a process for reducing the internal heating during rolling of this support following a drop in pressure. This safety support can be used for fitting on tyres of vehicles of the two-wheeler or automobile type, such as motorcycles or cars.

The use of elastomeric safety supports having closed cells is well-known, for competition tyres which are intended to roll on bumpy courses of the cross-country rally type.

These cellular supports are supposed to permit rolling at zero or very low pressure by ensuring tyre function following perforation of the tyre, over a distance depending in particular on the more or less severe conditions which characterise this type of rolling.

The cellular supports used for motorcycles are usually toric in shape and, prior to being mounted on a wheel rim, have a volume slightly greater than that of the interior space of the tyre, such that they are supposed permanently to occupy all the interior space of the corresponding tyres in order to support them at zero pressure.

Such supports are generally obtained by extruding a cross-linkable, expandable rubber composition which has been subjected to thermomechanical working, then by vulcanisation and expansion of this extruded composition in order to obtain a cross-linked, expanded support, owing to the thermal decomposition of a swelling agent which is initially present in the rubber composition.

Under severe rolling conditions at zero pressure, the heating of the support results in an increase in the permeability of the walls of the cells and, consequently, in gradual escape of part of the gas contained in the support. As a result, the volume of the support decreases, such that it no longer effectively ensures tyre function of the tyre after a certain amount of time has elapsed.

This internal heating is also liable completely to damage the support after a certain amount of time has elapsed. It is then no longer possible to consider driving.

The cellular supports used for automobiles are not supposed to occupy all the interior space of a tyre except when rolling with a flat tyre following a drop in pressure, owing to the fact that they are compressed by the inflation air of the tyre when rolling at normal pressure. The same disadvantages due to the internal heating of the support may occur following this drop in pressure.

Attempts have been made in the past to ensure that a cellular support for a motor vehicle can dilate sufficiently inside a tyre following a drop in pressure, so as to bear effectively on the tyre when rolling with a flat tyre. To this end, it has been proposed to provide this support with a fluid vaporisable at atmospheric pressure at a temperature of between 29°C and 135°C, preferably between 50°C and 90°C. Reference may be made to British Patent Specification GB-A-2 013 143 for the description of such a specific support for an automobile.

The rubber composition used for the support described in this document is preferably based on polyethylene foam. These compositions may also be based on a polypropylene or polyurethane foam, on a blend of nitrile rubber and polyvinyl chloride, or alternatively on 1,2-polybutadiene.

As for the fluid used, it is supposed to permit expansion of the support when rolling with a flat tyre when it vaporises owing to the increase in temperature within the tyre. This fluid may be formed of ethylene oxide, methyl chloride, "Freon", mono-alcohols, di-alcohols or water.

It will be noted that this support is not supposed to have minimised internal heating when rolling with a flat tyre.

The Applicant has surprisingly discovered that the association of water, in a quantity of from 3 phr to 6 phr (phr: parts by weight per hundred parts of elastomer(s)), with a diene elastomer having a molar ratio of units resulting from conjugated dienes which is less than 15%, in order to implement a first step of thermomechanical working of a process for manufacturing a cross-linked, expanded elastomeric safety support of cellular structure having closed cells, said support being intended to be mounted on a wheel rim within a tyre, said process consisting essentially,

- in this first step, of kneading a rubber composition comprising at least said diene elastomer, said water, a swelling agent to permit later obtaining of said cellular structure and a vulcanisation system,

- in a second, forming, step, of forming the rubber composition obtained at the end of the first step in order to obtain a cross-linkable, expandable support blank of predetermined section, and

- in a third, curing, step, of subjecting the blank obtained at the end of the second step to preliminary curing in a mould, then subjecting the pre-cured, demoulded blank to expansion and vulcanisation in order to obtain a cross-linked, expanded support by decomposition of said swelling agent,

makes it possible to obtain a cross-linked, expanded support which when rolling does not have the aforementioned disadvantages of loss of volume and deterioration which are caused by excessive internal heating, due to the vaporisation of the water during rolling.

"Diene" elastomer is understood to mean, in known manner, an elastomer (homopolymer or copolymer) resulting at least in part from diene monomers (monomers bearing two double carbon-carbon bonds, whether conjugated or not).

There are preferably used as diene elastomers having a molar ratio of units resulting from conjugated dienes which is less than 15% (these diene elastomers are commonly referred to as "essentially saturated") copolymers of isoprene and isobutylene (butyl or IIR rubbers), in particular owing to their reduced permeability to air. The halogenated versions of these copolymers, in particular halogenated or brominated versions (BIIR or CIIR rubbers, bromobutyl and chlorobutyl rubbers, respectively), can also be used.

Other diene elastomers corresponding to this definition are also usable, such as copolymers of dienes and alpha-olefins, for example terpolymers of ethylene, propylene and a diene (EPDM), and also the halogenated, in particular chlorinated or brominated, versions of this type of copolymer.

The swelling agent used in the first kneading step may be added to the diene elastomer and to the other constituents of the rubber composition in a quantity of from 15 phr to 30 phr, and it is preferably formed of azobisformamide.

According to another characteristic of the invention, there is added to said diene elastomer a reinforcing filler comprising carbon black and from 10 phr to 30 phr of silica, preferably from 15 phr to 25 phr, for implementing said first step.

In fact, tests have shown that blanks to be vulcanised in order to obtain cross-linked, expanded supports which do not comprise silica, but for example only carbon black as reinforcing filler, are the seat of significant, rapid decomposition of the swelling agent during said preliminary curing, owing to the presence of water in the blank. This decomposition of the swelling agent results in premature expansion of the blank during this preliminary curing, which makes it difficult to remove the pre-cured blank from the mould without damaging it.

It was possible to confirm that this presence of silica in the blank makes it possible to prevent this undesirable decomposition of the swelling agent during preliminary curing and, consequently, to permit demoulding under satisfactory conditions.

It will be noted that the silica added to the diene elastomer during the first kneading step may advantageously be hydrated, such that the water thus supplied by the silica is associated with the elastomer in the aforementioned quantity of from 3 to 6 phr.

The silica which may be used to manufacture the support of the invention may be any reinforcing silica known to the person skilled in the art, in particular any precipitated or fumed silica having a BET surface area and a CTAB specific surface area both of which are less than 450 m^2/g, even if the highly dispersible precipitated silicas are preferred.

In the present specification, the BET specific surface area is determined in known manner, in accordance with the method of Brunauer, Emmett and Teller described in "The Journal of the American Chemical Society", vol. 60, page 309, February 1938, and corresponding to Standard AFNOR-NFT-45007 (November 1987); the CTAB specific surface area is the external surface area determined in accordance with the same Standard AFNOR-NFT-45007 of November 1987.

"Highly dispersible silica" is understood to mean any silica having a very substantial ability to disagglomerate and to disperse in an elastomeric matrix, which can be observed in known manner by electron or optical microscopy on thin sections. As non-limitative examples

of such preferred highly dispersible silicas, mention may be made for example of the silicas Zeosil 1165 MP and 1115 MP from Rhodia.

Of course, "silica" is also understood to mean mixtures of different silicas, in particular of highly dispersible silicas such as described above.

Non-highly dispersible silicas may also be used, such as the silica Ultrasil VN3 from Degussa.

Suitable carbon blacks are in particular the blacks N339, N347, N375 and blacks of grade 5, 6 or 7. The mass fraction of carbon black present in the reinforcing filler may vary within wide limits, this quantity preferably being from 40% to 60%, for a mass fraction of silica of from 60 to 40%.

A cross-linkable, expandable blank according to the invention for an elastomeric safety support of cellular structure having closed cells, which comprises at least one diene elastomer and water, is such that said diene elastomer has a molar ratio of units resulting from conjugated dienes which is less than 15%, and that the water is present in said blank in a quantity of from 3 phr to 6 phr.

According to another characteristic of the invention, this cross-linkable, expandable blank comprises a reinforcing filler which itself comprises a blend of silica and of carbon black, the silica being present in the blank in a quantity of from 10 to 30 phr.

Preferably, this cross-linkable, expandable blank is such that said diene elastomer is a copolymer of isoprene and isobutylene.

A cross-linked, expanded elastomeric safety support according to the invention is obtained by the aforementioned process, and it comprises at least one diene elastomer having a molar ratio of units resulting from conjugated dienes which is less than 15%, and a reinforcing filler.

According to the invention, this cross-linked, expanded support is such that said reinforcing filler comprises silica such that the silica is present in the support in an amount of

from 10 to 30 phr, and it also comprises a swelling agent, for example azobisformamide, in a quantity equal to or greater than 2 phr.

Advantageously, the swelling agent is present in the cross-linked, expanded support of the invention in a quantity equal to or greater than 5 phr.

This relatively high quantity of swelling agent which is still present in the cross-linked, expanded support makes it possible to have a higher re-expansion potential when rolling at zero pressure, this re-expansion potential resulting in rolling effected at a higher pressure within the tyre.

The process according to the invention for reducing the internal heating of a safety support of cellular structure having closed cells, which is mounted on a wheel rim within a tyre in order to ensure tyre function of the tyre following a drop in pressure, consists in using a cross-linked, expanded support obtained by the aforementioned manufacturing process according to the invention.

The aforementioned characteristics of the present invention, as well as others, will be better understood on reading the following description of several examples of embodiment of the invention, which are given by way of illustration and not of limitation.

I. <u>Manufacture of a support according to the invention and a "control" support</u>:

Two safety supports of cellular structure having closed cells were manufactured which can be used in the cross-linked, expanded state for fitting in tyres of the motorcycle type, respectively a "control" support and a support according to the invention.

Each of these two supports has one and the same elastomeric matrix, which is formed of a copolymer of isoprene and isobutylene, and one and the same density substantially equal to 0.1.

These supports are intended to be used within a mounted assembly of dimensions 140/90-18 (in which the width of the tyre is 140 mm, the spacing between the rim seats is 90 mm and the diameter of the rim measured at the location of a rim seat is 18 inches).

Each support was manufactured using a manufacturing process which is described hereafter.

In a first step of thermomechanical working, in order to obtain each of the cross-linkable, expandable rubber compositions intended to constitute the aforementioned two supports, kneading in an internal mixer was effected of the corresponding composition comprising in particular said elastomeric matrix, a swelling agent and a vulcanisation system.

This first step is characterised by a drop temperature of about 120°C.

It will be noted that the cross-linkable, expandable composition intended to constitute a support according to the invention comprises water, unlike the "control" composition.

It will also be noted that this composition according to the invention comprises a blend of silica and carbon black as reinforcing filler, whereas the "control" composition comprises a reinforcing filler which is formed of carbon black.

The quantities used for introducing the various constituents into the mixer, in order to obtain these two cross-linkable compositions, are set forth in Table I below.

Table I: (phr: parts by weight per hundred parts of elastomer).

Constituents introduced into the mixer	Quantities (phr) of cross-linkable "control" composition	Quantities (phr) of cross-linkable composition "invention"
Carbon black N683	40	20
Hydrated silica	-	22.5
Aromatic oil	10	10
ZnO	4.5	4
Stearic acid	3.5	-
Anti-ozone wax	3	3
Antioxidant	2	-
Vulcanisation system:		
- sulphur	1.8	1.8
- tetramethylthiuram disulphide	1.4	1.4
- mercaptobenzothiazole	0.5	0.5
Swelling agent: (azobisformamide)	13	26

It will be noted that the hydrated silica used in the composition according to the invention has, on the one hand, a mass fraction of water which is substantially equal to 18% (the composition according to the invention thus having a quantity of water substantially equal to 4 phr) and, on the other hand, characteristics of BET and CTAB specific surface areas which are those of the silica "Zeosil 1165 MP".

It should be noted that the cross-linkable, expandable composition which is intended to constitute the support according to the invention has twice as much swelling agent as the "control" composition.

In a second step of the manufacturing process, the rubber composition obtained at the end of the first step was extruded to obtain a cross-linkable, expandable support blank of predetermined section which, in this example, is suitable for equipping, in the cross-linked, expanded state, motorcycle tyres corresponding to the aforementioned dimensions.

The temperature used for this extrusion is less than or equal to 100°C.

In a third, curing, step, preliminary curing in a mould of the support blank obtained at the end of the second step was effected, then the pre-cured blank was subjected to expansion and vulcanisation in a turntable-type oven, in order to obtain a cross-linked, expanded support by thermal decomposition of the swelling agent.

The vulcanisation temperature is between 140°C and 160°C.

It will be noted that the water content of the cross-linkable, expandable blank which is used in the process according to the invention is substantially 4 phr, whereas the water content of the blank intended to constitute the "control" support is substantially equal to 0.5 phr (the water present in this "control" blank comes essentially, firstly, from the molecules of water linked to the carbon black and, secondly, from the ambient humidity which is absorbed by the rubber composition).

It will also be noted that the presence of silica in the reinforcing filler for the blank according to the invention makes it possible to prevent the decomposition of the swelling agent during preliminary curing and, consequently, to permit demoulding which does not render the pre-cured blank fragile. In fact, it was confirmed that the latter is devoid of tears on its periphery at the location of the joint planes of the preliminary curing mould, following the demoulding thereof.

II. Comparison of the properties of the support according to the invention and the "control" support:

◊ Attempts were made to compare the respective densities of the cross-linked, expanded support according to the invention and "control" support which were obtained by the aforementioned process.

Table II hereafter summarises the average densities obtained for each of these supports, and the densities obtained at the core and at the periphery.

Table II:

	Average density	Core density	Peripheral density
"Control" support	0.095	0.062	0.130
Support according to the invention	0.095	0.044	0.165

These results show that the density gradient between the periphery and the core of the support is higher for the support according to the invention than for the "control" support. In fact, this density gradient, which is due to the strongly exothermic decomposition of the swelling agent during the expansion, is all the more significant the higher the quantity of swelling agent used in the initial thermomechanical step.

In this example of embodiment, it will be noted that the core and peripheral temperatures of the blanks during expansion reach 190°C and 150°C, respectively, whereas the azobisformamide which is used as swelling agent begins to decompose at a temperature of 130°C.

With regard to the cross-linked, expanded support according to the invention, it will be noted that it comprises an overall quantity of swelling agent of approximately 5 phr in combination with silica, unlike the cross-linked, expanded "control" support, which does not comprise any trace of swelling agent. More precisely, this support according to the invention comprises an average quantity of swelling agent of approximately 2 phr in its core (or central

zone of the support), whereas this quantity is substantially 8 phr in a peripheral layer of the support extending radially over approximately 1 cm from the outer face of said support.

Microscope analysis of the two supports obtained furthermore shows that in the case of the support according to the invention, the peripheral cells have a form approaching that of an oblong polyhedron, whereas in the case of the "control" support, they have a form of the type of a more regular polyhedron (substantially the shape of a dodecahedron).

◊ An attempt was made to compare the variation of volume of the support according to the invention with that of the "control" support, upon heating of these two supports from an initial temperature of 20°C to a temperature of at least 100°C, followed by cooling from this latter temperature to the initial temperature of 20°C.

The results obtained are shown in the form of indices in Tables III and IV hereafter.

- In Table III, V0 designates an index of initial volume relative to a base of 100, for each support at a temperature of 20°C,

V1 designates the volume index of each support following heating in an oven from 20°C to 100°C, and

V0' designates the volume index of each support following cooling from 100°C to 20°C.

An index greater than 100 following heating or cooling indicates swelling of the support (an index lower than 100 indicating shrinkage of the support).

Table III:

	V0	V1	V0'
"Control" support	100	125	94
Support according to the invention	100	148	96

It can be deduced from this, on one hand, that the support according to the invention dilates to a greater extent than the "control" support following an increase in its internal temperature to a temperature at which the water begins to vaporise and, on the other hand,

that this support of the invention, following a return to its initial temperature, returns to a volume which is closer to its initial volume than the "control" support.

- In Table IV, V0 designates the same index of initial volume relative to a base of 100, for each support at a temperature of 20°C,

V1' designates the volume index of each support following heating in an oven from 20°C to 150°C, and

V0" designates the volume index of each support following cooling from 150°C to 20°C.

Table IV:

	V0	V1'	V0"
"Control" support	100	137	89
Support according to the invention	100	210	142

It can be deduced from this, on one hand, that the support according to the invention dilates much more than the "control" support following an increase in its internal temperature to 150°C and, on the other hand, that this support of the invention acquires a volume which is greater by 42% than its initial volume following a return to its initial temperature, contrary to the "control" support, which shrinks.

This increase in volume of the support according to the invention was confirmed when rolling at zero pressure and under severe conditions, when it is fitted on a motorcycle mounted assembly. In fact, it was determined that the volume of this support, following its extraction from the mounted assembly after rolling at zero pressure, increased by 65% relative to the initial volume of the support before the rolling, this increase being greater than that measured following the aforementioned oven treatment at 150°C.

In other words, these Tables III and IV show that the support according to the invention has, owing in particular to the relatively high quantity of swelling agent which it comprises, a higher re-expansion potential when rolling at zero pressure than the "control" support, this re-expansion potential resulting in rolling effected at a higher pressure within the tyre.

◊ An attempt was also made to compare the internal heating when rolling at zero pressure of the support according to the invention to that of the "control" support. To this end, a running test was performed on a smooth-drum roller of one metre in diameter, and the evolution of the internal temperature of each support was monitored. It will be noticed that the absence of impact which characterises this running has practically no influence on this evolution of temperature.

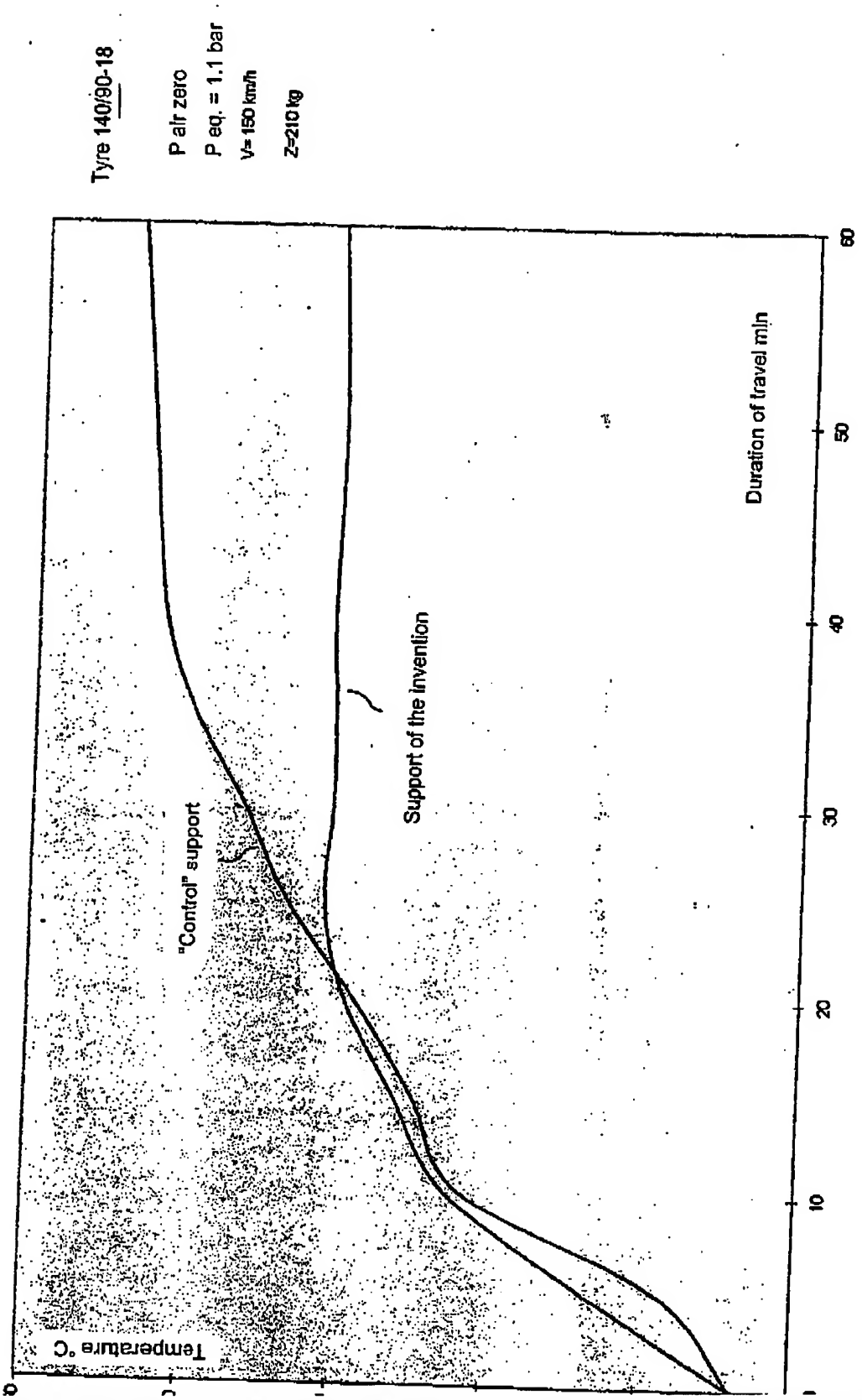
For each support, the mounted assembly having the dimensions mentioned in Section I was used.

The conditions of load on the mounted assembly and of speed of rolling were selected such that they were close to those relating to the special stages of cross-country rally-type competitions. More precisely, the load Z to which each mounted assembly was subjected was 210 kg, which corresponds to a conventional load bearing on the rear wheel of a cross-country rally motorcycle. As for the speed of rolling, it was maintained at 150 km/h.

The initial equivalent pressure within the tyre was 1.1 bar.

The graph below shows the evolution in the internal temperature of each support during such rolling at zero air pressure.

Page before correction



This graph shows stabilisation of the internal temperature of the support according to the invention at a temperature of approximately 150°C, substantially starting from 20 minutes' rolling at zero air pressure, whereas the internal temperature of the "control" support continues to increase after this rolling time and even exceeds 200°C after 40 minutes.

It will be noted that the support according to the invention may provide tyre function for the tyre for several hours, when rolling at zero pressure, without exhibiting deterioration and without damaging said tyre.

CLAIMS

1. A process for manufacturing a cross-linked, expanded elastomeric safety support of cellular structure having closed cells, said support being intended to be mounted on a wheel rim within a tyre, said process consisting essentially

- in a first step of thermomechanical working, of kneading a rubber composition comprising at least one diene elastomer, water, a swelling agent for permitting later obtaining of said cellular structure and a vulcanisation system,

- in a second, forming, step, of forming the rubber composition obtained at the end of the first step in order to obtain a cross-linkable, expandable support blank of predetermined section, and

- in a third, curing, step, of subjecting the blank obtained at the end of the second step to preliminary curing in a mould, then subjecting the pre-cured, demoulded blank to expansion and vulcanisation in order to obtain a cross-linked, expanded support by decomposition of said swelling agent,

characterised in that it consists in using, for implementing said first step, a diene elastomer having a molar ratio of units resulting from conjugated dienes which is less than 15%, and a quantity of water of from 3 phr to 6 phr (phr: parts by weight per hundred parts of elastomer(s)).

2. A process for manufacturing a cross-linked, expanded safety support according to Claim 1, characterised in that it consists in using, for implementing said first step, said swelling agent in a quantity of from 15 phr to 30 phr.

3. A process for manufacturing a cross-linked, expanded safety support according to Claim 1 or 2, characterised in that it consists of adding to said diene elastomer a reinforcing filler comprising carbon black and from 10 phr to 30 phr silica for implementing said first step.

4. A process for manufacturing a cross-linked, expanded safety support according to one of the preceding claims, characterised in that it consists in using a copolymer of isoprene and isobutylene as diene elastomer.

5. A process for manufacturing a cross-linked, expanded safety support according to one of the preceding claims, characterised in that it consists in using azobisformamide as swelling agent.

6. A cross-linkable, expandable blank for an elastomeric safety support of cellular structure having closed cells, said support being intended to be mounted on a wheel rim within a tyre, said blank comprising at least one diene elastomer and water, characterised in that said diene elastomer has a molar ratio of units resulting from conjugated dienes which is less than 15%, and in that the water is present in said blank in a quantity of from 3 phr to 6 phr (phr: parts by weight per hundred parts of elastomer(s)).

7. A cross-linkable, expandable blank according to Claim 6, characterised in that it comprises a reinforcing filler comprising a blend of silica and carbon black, the silica being present in said blank in a quantity of from 10 to 30 phr.

8. A cross-linkable, expandable blank according to Claim 6 or 7, characterised in that said diene elastomer is a copolymer of isoprene and isobutylene.

9. A cross-linked, expanded elastomeric safety support of cellular structure having closed cells obtained by a process according to one of Claims 1 to 5, said support being intended to be mounted on a wheel rim within a tyre, said support comprising at least one diene elastomer having a molar ratio of units resulting from conjugated dienes which is less than 15%, and a reinforcing filler, characterised in that said reinforcing filler comprises silica such that the silica is present in the support in an amount of from 10 to 30 phr, and in that said support also comprises a swelling agent in a quantity equal to or greater than 2 phr.

10. A cross-linked, expanded elastomeric safety support according to Claim 9, characterised in that said swelling agent is present in said support in a quantity equal to or greater than 5 phr.

11. A cross-linked, expanded elastomeric safety support according to Claim 9 or 10, characterised in that said swelling agent is formed of azobisformamide.

12. A process for reducing the internal heating during rolling of a safety support of cellular structure having closed cells, which is mounted on a wheel rim within a tyre in order to ensure tyre function of the tyre following a drop in pressure, characterised in that it consists in using a cross-linked, expanded support obtained by a process according to one of Claims 1 to 5.

Corrected page

CLAIMS

1. A process for manufacturing a cross-linked, expanded elastomeric safety support of cellular structure having closed cells, said support being intended to be mounted on a wheel rim within a tyre, said process consisting essentially

- in a first step of thermomechanical working, of kneading a rubber composition comprising at least one diene elastomer, water, a swelling agent for permitting later obtaining of said cellular structure and a vulcanisation system,

- in a second, forming, step, of forming the rubber composition obtained at the end of the first step in order to obtain a cross-linkable, expandable support blank of predetermined section, and

- in a third, curing, step, of subjecting the blank obtained at the end of the second step to preliminary curing in a mould, then subjecting the pre-cured, demoulded blank to expansion and vulcanisation in order to obtain a cross-linked, expanded support by decomposition of said swelling agent,

characterised in that it consists in using, for implementing said first step, a diene elastomer having a molar ratio of units resulting from conjugated dienes which is less than 15%, and a quantity of water of from 3 phr to 6 phr (phr: parts by weight per hundred parts of elastomer(s)).

2. A process for manufacturing a cross-linked, expanded safety support according to Claim 1, characterised in that it consists in using, for implementing said first step, said swelling agent in a quantity of from 15 phr to 30 phr.

3. A process for manufacturing a cross-linked, expanded safety support according to Claim 1 or 2, characterised in that it consists of adding to said diene elastomer a reinforcing filler comprising carbon black and from 10 phr to 30 phr silica for implementing said first step.

This graph shows stabilisation of the internal temperature of the support according to the invention at a temperature of approximately 150°C, substantially starting from 20 minutes' rolling at zero air pressure, whereas the internal temperature of the "control" support continues to increase after this rolling time and even exceeds 200°C after 40 minutes.

It will be noted that the support according to the invention may provide tyre function for the tyre for several hours, when rolling at zero pressure, without exhibiting deterioration and without damaging said tyre.

4. A process for manufacturing a cross-linked, expanded safety support according to one of the preceding claims, characterised in that it consists in using a copolymer of isoprene and isobutylene as diene elastomer.

5. A process for manufacturing a cross-linked, expanded safety support according to one of the preceding claims, characterised in that it consists in using azobisformamide as swelling agent.

6. A cross-linkable, expandable blank for an elastomeric safety support of cellular structure having closed cells, said support being intended to be mounted on a wheel rim within a tyre, said blank comprising at least one diene elastomer and water, characterised in that said diene elastomer has a molar ratio of units resulting from conjugated dienes which is less than 15%, and in that the water is present in said blank in a quantity of from 3 phr to 6 phr (phr: parts by weight per hundred parts of elastomer(s)).

7. A cross-linkable, expandable blank according to Claim 6, characterised in that it comprises a reinforcing filler comprising a blend of silica and carbon black, the silica being present in said blank in a quantity of from 10 to 30 phr.

8. A cross-linkable, expandable blank according to Claim 6 or 7, characterised in that said diene elastomer is a copolymer of isoprene and isobutylene.

9. A cross-linked, expanded elastomeric safety support of cellular structure having closed cells obtained by a process according to one of Claims 1 to 5, said support being intended to be mounted on a wheel rim within a tyre, said support comprising at least one diene elastomer having a molar ratio of units resulting from conjugated dienes which is less than 15%, and a reinforcing filler, characterised in that said reinforcing filler comprises silica such that the silica is present in the support in an amount of from 10 to 30 phr, and in that said support also comprises a swelling agent in a quantity equal to or greater than 2 phr.

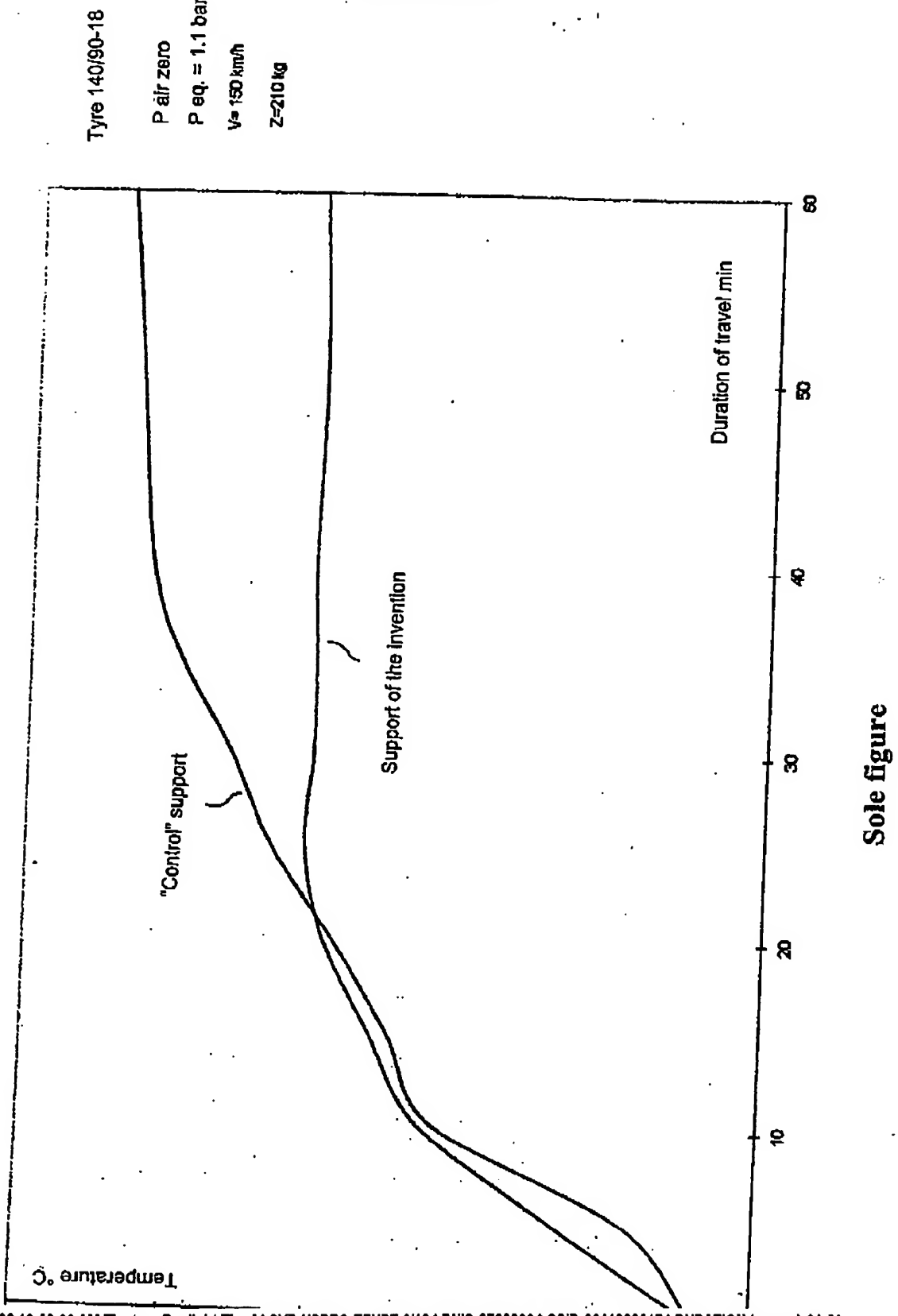
10. A cross-linked, expanded elastomeric safety support according to Claim 9, characterised in that said swelling agent is present in said support in a quantity equal to or greater than 5 phr.

11. A cross-linked, expanded elastomeric safety support according to Claim 9 or 10, characterised in that said swelling agent is formed of azobisformamide.

12. A process for reducing the internal heating during rolling of a safety support of cellular structure having closed cells, which is mounted on a wheel rim within a tyre in order to ensure tyre function of the tyre following a drop in pressure, characterised in that it consists in using a cross-linked, expanded support obtained by a process according to one of Claims 1 to 5.

Corrected page

Sole sheet



Sole figure